1,163,335

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Hydraulic Accumulators

We, GREER HYDRAULICS, INC., a corporation organised under the laws of the state of New York, United States of America, of 5930 W. Jefferson Boulevard, Los Angeles 16, California, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to hydraulic accumulators.

Hydraulic accumulators are often used in hydraulic systems to take up sudden surges in the pressure lines and to supply liquid under pressure to hydraulic actuators in the system.

In order to take up such sudden surges of pressure, the accumulators generally having a relatively large liquid port which provides unrestricted flow into the liquid chamber of the accumulator. Where the liquid port also permits unrestricted flow out of the liquid chamber and the accumulator is of the type having a flexible partition, such as a deformable bladder, acting as a separator between the gas and liquid chambers of the accumulator which are charged with gas and oil under pressure, if there should be a sudden large differential between the pressures inside and outside the accumulator, due to the higher pressure inside the accumulator, the bladder which is compressed, will expand rapidly.

As a result of such rapid expansion of the bladder, if the liquid port remains open, the unrestricted flow may cause the hydraulic actuator to effect movement of the movable which it controls at an excessive rate of speed with resultant mechanical failure.

According to the invention, there is provided a hydraulic accummulator comprising a rigid container having a liquid port therein, a deformable and elastic bladder secured in the container to divide the container into two chambers, one of which is a liquid chamber in communication with the liquid port, the liquid port being defined by a sleeve extending outwardly from the container and having at its inner end a valve seat for a closure valve member carried by the bladder for closing the liquid port when the bladder is fully distended, wherein a restrictor valve member is slidably mounted in the sleeve and is movable between an innermost position and an outermost position relative to the container, the restrictor valve member having first and second passageways therethrough, the second passageway having a smaller cross sectional area than the first passageway and being open in all positions of the restrictor valve member whereas means are provided for closing the first passageway when the restrictor valve member is in its outermost position.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal sectional view of an accumulator according to the invention,

Fig. 2 is a longitudinal detail sectional view on an enlarged scale showing the oil port construction of the accumulator of Fig. 1,

Fig. 2*a* is a fragmentary detail sectional view with parts broken away showing the valve member in closed position,

Fig. 3 is a top plan view of the valve member of the accumulator, and

Fig. 4 is a diagrammatic view showing a typical installation of the accumulator.

The hydraulic accumulator shown in Fig. 1, comprises a substanially cylindrical container 11 of rigid material such as steel or aluminium, capable of withstanding the pressure to which it is to be subjected in use.

The container 11 has one end closed at 12 and a sleeve 13 is positioned in an axial opening 14 in the closed end 12. The inner end 15 of the sleeve has an outwardly extending annular flange 16 which rests on the periphery of the oepning 14, and the sleeve is secured in fixed position as by welding at 17.

The bore 18 of the sleeve 13, which defines

[*Price 4s. 6d.*]

a port through which fluid may flow, has its inner end 19 beveled to define a valve seat.

Positioned in the mouth of the container 11 remote from the closed end 12 thereof is a substantially cup-shaped cover member 21 which has an annular groove 22 in its outer surface of the side wall 23. The portion 24 of the side wall 23 between the groove 22 and the periphery or inner end 25 of the said side wall 23 is of reduced diameter so that the outer surface of the side wall portion 24 will be spaced from the inner surface of the container wall when the cover member 21 is positioned therein.

The cover member 21 has a peripheral rim 28 rising from the outer surface 29 thereof. The central portion 31 of the cover member 21 presents a flat surface 32 which is in a plane extending beyond the plane of the end 33 of the rim 28 and the top surface of the cover member from the root end of the rim 28 to the periphery of the central portion 31 is inclined upwardly as at 34.

Positioned in the container 11 is a deformable partition in the form of an elongated bladder 35 made of an elastomeric material such as rubber. The bladder 35 is closed at one end at 36 and the mouth of the bladder has a pair of spaced inwardly extending beads 37, 38.

The bead 37 is designed to be accommodated in the annular groove 22, and the bead 38 is designed to be positioned beneath the end 25 of the side wall 23 of the cover member.

When so mounted with the cover member 21 positioned in the container, the bead 37 will be compressed in the annular groove 22 to form a fluid seal and the bead 38 will be retained beneath the end 25 of the side wall 23, the portion 30 of the bladder wall between the beads 37, 38 being under tension.

In order to retain the cover member 21 in the container, the periphery 40 of the mouth of the container 11 is bent inwardly as shown so that it extends over the end 33 of the rim 28 and the inner edge 39 of the periphery 40 is bent downwardly into the annular recess 41 defined by the inclined portion 34 of the outer surface of the cover member.

Secured to the central portion 31 of the cover member 21 as by screws 42 is a disc 43, the periphery 44 of which will rest on the periphery 40 of the mouth of the container 11 to retain the end 33 of the rim 28 against the undersurface of the periphery 40.

As is shown in Fig. 1, the bladder 35 is substantially frusto-conical in cross section, its side wall 45 being of greater diameter at the portion thereof adjacent the bead 38 than at the closed end 36 thereof. The bladder can be charged with a gas under pressure through a port 48 defined by an axial bore extending through the central portion 31 of the cover member 21 and through axial boss 49 depending from the undersurface of the cover member. The boss 49 has a suitable air valve 51 therein which is concealed by the disc 43.

Mounted on the closed end 36 of the bladder 35 is a valve member 52 in the form of a hollow button, preferably formed from thin steel or aluminium. The valve member is substantially frusto-conical in cross section with the smaller diameter portion or apex thereof having a guide recess 53 therein. The mouth of the valve member 52 has an inwardly extending flange or rim 54 which defines the top wall of the valve member and the inner periphery 55 of said rim 54 defines an opening axially aligned with the recess 53.

The side wall 56 of the valve member is capable of moving on to the bevelled seat 19 to prevent extrusion of the bladder through port 18.

As is shown in Fig. 2, the outer end 61 of the bore 18 of sleeve 13 is internally threaded to receive the externally threaded end of a pipe nipple 62. The nipple 62 has an outstanding annular flange 63 at its outer end designed to abut against the outer end 64 of sleeve 13 to limit the inward movement of the nipple. An annular groove 65 is positioned in the root end of the nipple to accommodate a seal ring 66 which will be compressed between the wall of groove 65 and the bevelled inner surface 67 of bore 18 at the outer end thereof when the nipple is tightened to define a seal.

The bore 18 of sleeve 13 has an annular shoulder 68 formed therein to serve as a stop to limit the inward movement of a valve member 69, the inner end 71 of the nipple 62 limiting the outward movement of the valve member 69.

As is shown in Figs. 2 and 3, the valve member 69 is a disc of rigid material which has a central passageway 72 therethrough and a passageway formed by a plurality of arcuate part-annular openings 73 extending therethrough adjacent the periphery 74 of the valve member 69.

The passageway 72 is axially aligned with the bore 18 of sleeve 13 and the arcuate openings 73 are aligned with the inner end 71 of the nipple 62.

As shown in Figs. 2 and 3, the width of the annular shoulder 68 is substantially the same as the width of the portion 75 of the valve member 69 between the outer periphery 76 of the arcuate openings 73 and the outer periphery 74 of the valve member. Thus, when the portion 75 of the valve member 69 abuts against shoulder 68 there will be unrestricted flow through the arcuate openings 73.

The width of the inner end 71 of nipple 62 is greater than that of the arcuate openings 73 so that when the valve member 69 is seated

against the end 71 of the nipple 62 the arcuate openings 73 will be closed and there will be flow only through the central passageway 72.

The total cross sectional area of the arcuate openings 73 and central passageway 72 is not less than the cross sectional area of the inner end 77 of the bore 78 of nipple 62. The cross-sectional area of the annular opening "a" (Fig. 2) between the inner end 71 of nipple 62 and the undersurface 79 of valve member 69 when it is seated on shoulder 68 together with the area of central passageway 72 is substantially equal to the area of the inner end 77 of bore 78.

As a result of the foregoing, it is apparent that when the valve member 69 is seated on shoulder 68 there will be substantially unrestricted flow of fluid through the sleeve 13 into the accumulator and when the valve member 69 is seated on the inner end 71 of nipple 62 the sole flow from the accumulator will be through the central passageway 72 and hence such outward flow will be restricted to a fraction of the inward flow.

Although the accumulator above described is suitable for a wide variety of applications, in which inward flow must be unrestricted and outward flow restricted, one typical application is shown in Fig. 4.

Here, the accumulator is associated with an agricultural plough.

As illustratively shown in Fig. 4, the plough has a main frame 81 which mounts a plurality of ploughshares 82, only one of which is shown. Each ploughshares 82 is pivotally mounted at 83 to the undersurface of the frame 81. The ploughshare is maintained in operative position by means of a hydraulic actuator 85 pivotally mounted at one end as at 86 to the frame and having its piston rod 87 pivotally connected to the ploughshare at 88.

When the piston 89 of the actuator is forced outwardly by the application of fluid under pressure applied to the port 91 of the actuator 85, the ploughshare 82 will pivot in a clockwise direction limited by the abutment of a projection 92 on the upper portion of the share against an adjustment screw 93.

As illustrated in Figure 4, the port 91 is connected by line 94 to the nipple 62 of the accumulator and through a releasable one-way valve 95 to charging valve 96.

In the operation of the hydraulic system shown in Fig. 4 with the disc 43 (Fig. 1) removed, the chamber 60 defined by bladder 35 is charged with gas under pressure through a port constituted by a bore 48. As a result, the bladder 35 will expand, substantially filling the container 11 and the valve member 52 will move downwardly until it seats on the bevelled end 19 of sleeve 13 thereby closing port 18 and preventing extrusion of the bladder therefrom.

At this time with the accumulator in vertical position, the valve member 69 due to its weight, will be seated on the inner end 71 of nipple 62.

A source of oil under pressure greater than that of the gas in bladder 35 is then applied through open valve 96 to charge the hydraulic system. Such oil will flow past one-way valve 95, through line 94 into the port 91 of hydraulic actuator 85 to pivot the ploughshare 82 in a clockwise direction limited by the abutment of projection 92 against screw 93. In addition, the oil under pressure will flow through the bore 78 of nipple 62 and react against the undersurface 79 of the valve member 69. As a result, the valve member 69 will quickly move inwardly until its peripheral portion 75 abuts against annular shoulder 68.

This movement which is only a relatively slight amount, will completely open the arcuate openings 73 and the oil under pressure will flow substantially unrestricted through the arcuate openings 73 as well as through central passageway 72 to react against the valve member 52 carried by bladder 35 and quickly move the latter off its seat to permit charging of chamber 61 defined between the outer surface of bladder 35 and container 11.

As a result, the bladder 35 will be deformed further to compress the gas therein.

The accumulator is charged until the pressure has built up to an amount so as to enable the actuator to exert the desired force against the ploughshare 82 which depends upon the particular plough construction involved.

Thereupon, the valve 96 is closed and the plough is ready for operation.

When the plough is pulled through a field by a tractor, due to the force exerted by the hydraulic actuator which is supplied by the charged accumulator, the ploughshare will remain in the position shown in Fig. 4 to provide the desired ploughing action.

If the ploughshare should hit an underground obstruction such as a rock R, for example, a sudden force will be built up tending to rotate the ploughshare in a counterclockwise direction about its mount 83. As a result, the piston 89 will be moved rearwardly causing a sudden surge of pressure in the oil in line 94. The oil which will be flowing at a high rate of speed will flow through nipple 62 of the accumulator and react against the undersurface 79 of valve member 69 so that the latter will be forced upward against its seat 68. As a result, there will be substantially unrestricted flow of oil through nipple 62 into the oil chamber 61 of the accumulator through arcuate openings 73. This will immediately deform the bladder 35 to compress the gas therein to take up the sudden shock and permit such pivoting movement of the ploughshare 82.

As the plough is further advanced, the ploughshare 82 will ride over the obstruction and when this occurs the force exerted to move the piston 89 rearwardly will be suddenly re-

leased. As a result, there will be a sudden large differential between the pressure inside the accumulator and the pressure in the actuator.

Due to such pressure differential, the force exerted against the top surface 99 of the valve member 69 will be far greater than that exerted against the bottom surface 79 of such valve member so that the valve member 69 will rapidly be forced outwardly against the end surface 71 of the nipple 62. This will cause the arcuate openings 73 to be closed so that the fluid will only be able to flow through the relatively small central passageway 72 into the line 94 and into port 91 of the hydraulic actuator. As a result of such restriction of flow from the accumulator, the bladder 35 therein will expand relatively slowly so that the valve member 52 carried by the bladder 35 will remain spaced from the valve seat 19.

Since the fluid under pressure is flowing into the hydraulic actuator at a relatively slow rate, the piston 89 of such actuator will move outwardly relatively slowly so that the ploughshare 82 will be pivoted relatively slowly back into its normal operation position.

This is to be contrasted with a different system in which a high rate of flow from the accumulator is provided as soon as the ploughshare 82 moves away from the obstruction R and the force against the ploughshare is suddenly eliminated. In such a situation, due to the unrestricted high rate of flow from the accumulator, the ploughshare 82 would be rapidly forced toward its normal operating position. However, due to the resistance of the soil, and especially where the latter is hard, the ploughshare would not move rapidly through the soil, and hence the plough frame 81 itself would move outwardly, causing extreme vibration and in addition the ploughshare would ride on the top surface of the ground and hence the desired uninterrupted furrow which the ploughshare is designed to form would be broken. This problem is of course enhanced when it is considered that the plough frame 81 normally carries several ploughshares, and if one or more of the ploughshares should suddenly be released after being restrained by an obstruction, irregular impact would be caused to the plough frame with the resultant likelihood of breakage of pivotal connections and the equipment carried by the frame. However, with the accumulator above described, due to the restricted flow of fluid outwardly from the accumulator, the force exerted by the actuator against the plough will build up relatively slowly thereby preventing a sharp impact of the ploughshare against the ground. Consequently, the plough frame will not be disturbed and the ploughshare will move into the ground to the desired operating position.

With the accumulator above described which has relatively few moving parts and is not likely to become deranged, substantially unrestricted flow into the accumulator and restricted flow out of the accumulator are achieved.

WHAT WE CLAIM IS:—

1. A hydraulic accumulator comprising a rigid container having a liquid port therein, a deformable and elastic bladder secured in the container to divide the container into two chambers, one of which is a liquid chamber in communication with the liquid port, the liquid port being defined by a sleeve extending outwardly from the container and having at its inner end a valve seat for a closure valve member carried by the bladder for closing the liquid port when the bladder is fully distended, wherein a restrictor valve member is slidably mounted in the sleeve and is movable between an innermost position and an outermost position relative to the container, the restrictor valve member having first and second passageways therethrough, the second passageway having a smaller cross sectional area than the first passageway and being open in all positions of the restrictor valve member whereas means are provided for closing the first passageway when the restrictor valve member is in its outermost position.

2. A hydraulic accumulator according to claim 1, wherein the restrictor valve member is a rigid disc and the sleeve has an internal abutment to restrict inward movement of said disc.

3. A hydraulic accumulator according to claim 2, wherein the said internal abutment is formed by an internal annular shoulder of the sleeve against which the periphery of the inner surface of the disc abuts to restrict inward movement of said disc.

4. A pressure accumulator according to claim 3, wherein the said first passageway is constituted by a plurality of arcuate openings through the disc adjacent the periphery thereof and the second passageway is a central bore through the disc.

5. A hydraulic accumulator according to claim 4, wherein a pipe nipple is secured in the outer end of the sleeve, the inner end of the nipple being longitudinally spaced from the said annular shoulder, the outer surface of said disc abutting against the inner end of said nipple to restrict outward movement of said disc, and the annular shoulder is of width to provide full clearance for the adjacent ends of the said arcuate openings when the disc abuts thereagainst and the inner end of the nipple is of sufficient to close the adjacent ends of the arcuate openings when the disc abuts thereagainst.

6. A hydraulic accumulator according to claim 5, wherein the cross-sectional area of the inner end of the bore in the pipe nipple is substantially equal to the annular area defined by the space between the undersurface of the disc and the inner end of the nipple when the disc abuts against the annular shoulder and

the total cross sectional area of the arcuate openings and the central bore is not less than the cross sectional area of the inner end of the nipple bore.

7. A hydraulic accumulator according to claim 5 or 6, wherein the radial width of the annular shoulder is substantially equal to the radial width of the portion of said disc radially outwardly of the arcuate openings and the width of the inner end of the nipple is greater than the radial width of the arcuate openings.

8. A hydraulic accumulator according to claim 7, in which the peripheral surface of the disc is a close sliding fit in the portion of the sleeve between the annular shoulder and the inner end of the nipple and the thickness of said disc is more than half the length of the said portion of the sleeve.

9. A hydraulic accumulator substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

10. A plough comprising a ploughshare pivotally mounted on a plough frame, a hydraulic actuator connected between the ploughshare and the plough frame to rotate the ploughshare, the actuator being connected to the liquid port of a hydraulic accumulator according to any of the preceding claims.

11. A plough according to claim 10, including a pressurised hydraulic supply for the actuator.

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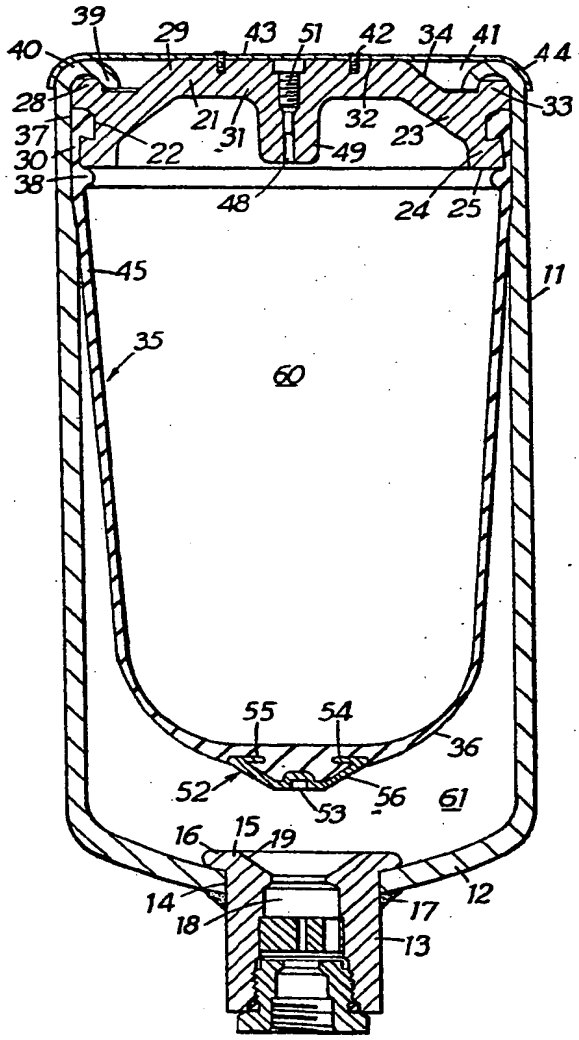
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1.



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Sheet 2

Fig.2.

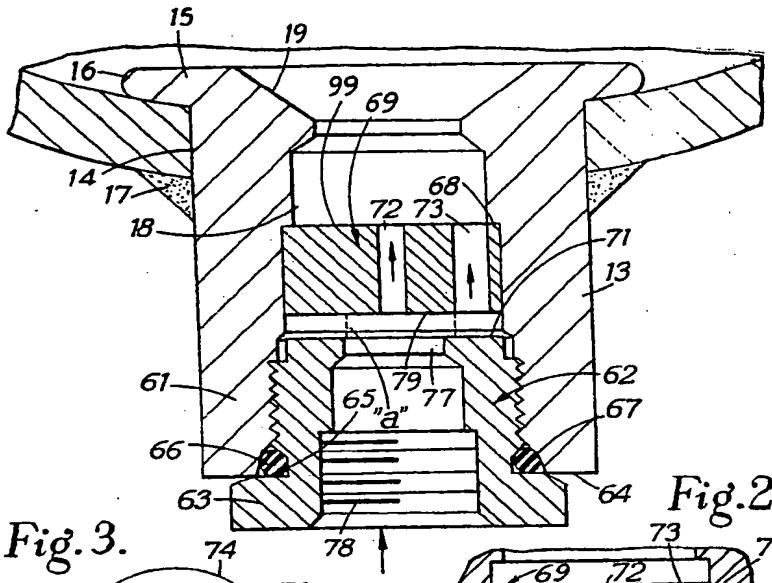

Fig.2a.

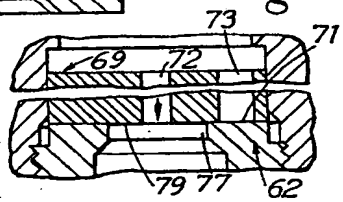

Fig.3.

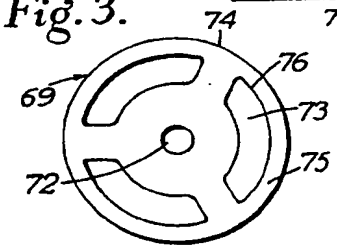

Fig.4.